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EXAMINER NELSON, MICHAEL E				
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08/26/2008		PAPER		

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/506,914

Applicant(s)

MAXTED ET AL.

Examiner

MICHAEL E. NELSON

Art Unit

1794

Period for Reply -- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 05 June 2008.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-8, 11, 13, 14, 16-24, 26-32 and 34-40 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-8, 11, 13, 14, 16-24, 26-32 and 34-40 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

Status of Claims

1. In response to Applicant's reply dated 06/05/2008, claims 1-8, 11, 13-14, 16-24, 26-32, 34-40 are pending.

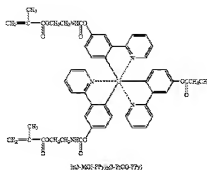
Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

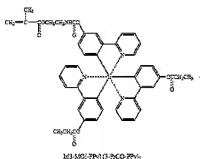
A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1-4, 11, 13-14, 17-24, 26, 28-29, 35-39 are rejected under 35 U.S.C. 102(e) as being anticipated by Takeuchi et al. (US 7,396,598).
4. Concerning claims 1-4, Takeuchi et al. describe polymerizable compositions comprising a crosslinkable material and a phosphorescent material. As an example, Takeuchi et al. disclose a mixture of the crosslinkable material shown below. The materials are used without supplemental charge transport materials, indicating that the polymer material itself transport charges inherently.



5. The material comprises a charge transporting fragment (in this case an iridium metal complex), and a phosphorescent material, shown below (See examples 16 and 19, scheme B and D, columns 109-114)



6. Concerning claim 2, since the charge transporting material is very similar in structure to the phosphorescent material, it is reasonable to predict that the triplet energy levels are substantially equal.
7. Concerning claims 3 and 4, the structure shown above has X groups which are acrylic groups (per claim 4), which have an ethylenic unsaturation.
8. Concerning claim 11, Takeuchi et al. describes the use of a polymerizable light emitting compound, in conjunction with a polymerizable electron transporting compound, specifically including bisstyryloxadiazole (See column 85, line 65- column 86, line 13).

9. Concerning claims 13-14, the phosphorescent material is a phosphorescent metallic complex of iridium (per claim 14), as shown above.
10. Concerning claims 17-18, Takeuchi et al. discloses that the polymerizable composition **may** contain an initiator (column 86, lines 30-32).
11. Concerning claims 19-20, 28-29, Takeuchi et al. discloses that a layer may be formed by forming a polymerizable composition into a film on a substrate and then polymerizing the material to form a polymer (column 87, lines 41-46), and that the polymer can be formed by thermal or optical (actinic) polymerization (per claims 28-29) (column 86, lines 39-45).
12. Concerning claim 21, and 35 Takeuchi et al. describes the formation of the polymerizable material into a film, which will naturally have some predetermined pattern.
13. Concerning claims 22, 23-24, 26, and 36-39 Takeuchi et al. describe an organic light emitting device comprising in sequence a substrate (1), an electrode (anode, 2), a hole transport layer (3) between the anode and light emitting layer (per claim 24), a light emitting layer (4), and an electron transport layer (5) between the light emitting layer and the cathode (per claim 26), and a cathode (6). (See Fig 1., column 55, lines 32-37) Furthermore, the light emitting layer may consist of two ore more laminated layers (per claim 22) (column 55, lines 51-54), where the polymerisable material described is used in the light emitting layer.

Claim Rejections - 35 USC § 103

14. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

15. Claims 16 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Takeuchi et al. (US 7,396,598).

Takeuchi et al. describe the polymerizable composition discussed above, Takeuchi et al. further disclose that the polymerizable composition contains at least one polymerizable compound other than the light emitting compound (column 4, lines 64-67) and that the polymerizable compound other than the light emitting compound is a crosslinking polymerizable compound having two or more polymerizable functional groups (column 5, lines 6-10). Takeuchi et al. disclose that the polymerizable compound may be a light emitting compound with a polymerizable functional group, along with electron and hole transporting compounds having a polymerizable functional group (column 59, lines 53-60). Given this teaching it would have been obvious to one of ordinary skill to use crosslinkable hole transporting materials in combination with the polymerizable light emitting compound. Takeuchi et al. are silent on the specific amount of the phosphorescent material in the composition.

16. Takeuchi et al. do describe mixtures of or the phosphorescent material with small molecule hole and electron transport materials, however, disclosing mixtures where the hole transport material preferably comprises 0 to 100% by mass, and the electron transport component is preferably from 0 to 200% by mass (column 61, lines 26-40), and that the charge transporting compound serves to increase the carrier transportability of the material (column 60, lines 15-22). The concentration of

phosphorescent material is an optimizable feature, and it would have been obvious to one of ordinary skill to adjust the relative concentrations of the components of the polymerizable composition to optimize the function of the resulting electroluminescent device.

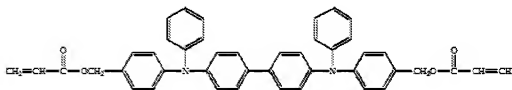
17. Claims 5-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Takeuchi et al. (US 7,396,598) as applied to claim 1 above, and further in view of Kikuchi et al. (6,416,915).

18. Concerning claims 5-8, Takeuchi et al. describe the polymerizable composition discussed above. Takeuchi et al. further disclose that the polymerizable composition contains at least one polymerizable compound other than the light emitting compound (column 14, lines 64-67) and that the polymerizable compound other than the light emitting compound is a crosslinking polymerizable compound having two or more polymerizable functional groups (column 5, lines 6-10). Takeuchi et al. disclose that the polymerizable compound may be a light emitting compound with a polymerizable functional group, along with hole transporting compounds having a polymerizable functional group (column 59, lines 53-60). Given this teaching it would have been obvious to one of ordinary skill to use crosslinkable hole transporting materials in combination with the polymerizable light emitting compound. Takeuchi et al. are silent on hole transporting materials having carbazole or arylamine structures.

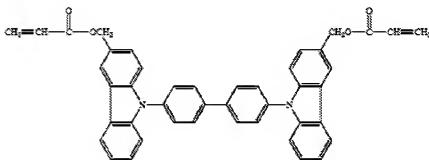
19. Kikuchi et al. describe polymerizable hole transporting compounds having at least two chain polymerization functional groups in the molecule for use in

electrophotographic apparatus (abstract, column 5, lines 7-12). While the materials are not described for use in electroluminescent devices, they are shown to have a hole transporting functionality, as taught by Takeuchi et al., and are polymerizable and crosslinkable, as required by Takeuchi et al., and would therefore be available to one of ordinary skill.

20. Kikuchi et al. describe hole transport materials formed from polymers having two polymerizable groups, such as those shown below.



24



31

21. The materials described have either a carbazole or arylamine structure (per claim 5), and meet the requirements of claim 6 where Ar is biphenyl, and where Ar₁ and Ar₂, as well as Ar₃ and Ar₄ are linked to form carbazole groups, as shown in structure 31.

22. Given the teaching by Takeuchi et al. of the use of a polymerizable hole transporting material, and the preference that the polymerizable material be capable of crosslinking, and the teaching by Kikuchi et al. of crosslinkable hole transporting

materials used in organic electronic devices for higher levels of mechanical strength and charge transporting performance, it would have been obvious to one of ordinary skill in the art to use the hole transporting material described by Kikuchi et al. in the polymerizable composition described by Takeuchi et al.

23. Claims 27 and 40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Takeuchi et al. (US 7,396,598) as applied to claims 23 and 37 above, and further in view of Miglitorato et al. (4,834,505).

24. Concerning claims 27 and 40, Takeuchi et al. describes the polymerizable compositions discussed above, and organic electroluminescent devices comprising those devices, having one layer or multiple layers in the light emitting layer. Takeuchi et al. are silent on devices having active matrix addressing.

25. Miglitorato et al. describe circuitry useful for liquid crystal displays and electroluminescent cells (column 9, lines 23-29). Miglitorato et al. further describe that active matrix addressing is known in the art, to identify uniquely the cell to be switched at any one time and prevent partial switching of other cells. (column 1, lines 16-26).

26. It would have been obvious to one of ordinary skill in the art to use active matrix addressing for the electroluminescent devices described by Takeuchi et al. for the purpose of incorporating the electroluminescent device into a display device.

27. Claims 30-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Takeuchi et al. (US 7,396,598) as applied to claim 29 above, and further in view of Okunaka et al. (6,696,181).

28. Concerning claims 30-32, Takeuchi et al. describe the polymerizable composition discussed above, which describes forming a film of the compositions followed by polymerization, either by heat or radiation treatment, and organic electroluminescent devices, including those with multiple light emitting layers. Takeuchi et al. are silent on patterning the film by exposure through a mask, and then removing the exposed film to remove unexposed material.

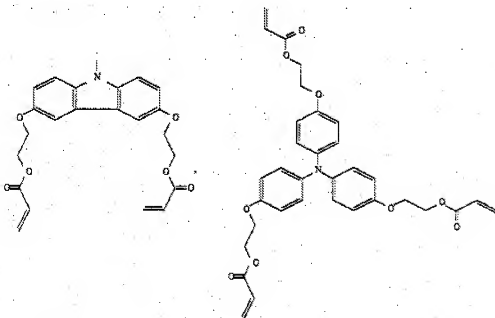
29. Okunaka et al. describe a method for forming an organic electroluminescent device where a polymerizable composition containing a dopant is deposited on a substrate (column 25, lines 26-36), and then film is crosslinked by exposure to ultraviolet radiation via a photomask. (column 26, lines 25-26) The unexposed area was developed by immersion in N-methylpyrrolidone, followed by rinsing with acetone to remove unexposed material. (column 26, lines 36-39).

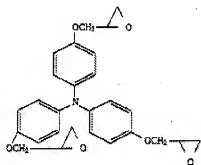
30. Given the general teaching by Takeuchi et al. that the film can be structured by imagewise exposure, and the specific teaching by Okunaka et al. where the film is exposed to actinic radiation through a photomask, followed by treatment with solvent to remove unexposed material. It would have been obvious to one of ordinary skill in the art to use the specific method described by Okunaka et al. on the device described by Takeuchi et al., since the method would be predicted to work in the same manner.

31. Furthermore, it would have been obvious to one of ordinary skill to repeat the process steps described by Okunaka et al. to form a second layer (as described by Takeuchi et al.). Takeuchi et al. describes numerous compositions suitable for forming the layer, and it would have been obvious to one of ordinary skill to use a different composition in the second layer, which is capable of emitting a second color different from the first color (by virtue of being different materials).

32. Claims 1-5, 11,13-14, 16-21, 23-24, 26, 28-29, 34-35, and 37-39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Funhoff et al. (5,518,824) in view of Lamansky et al. (Organic Electronics, vol. 2, no. 1, pp. 53-62, 2001).

33. Concerning claim 1, Funhoff et al. describe compositions comprising a polymerisable compound which undergoes polymerization on exposure to heat or actinic radiation such as the compounds shown below: (columns 7-9)



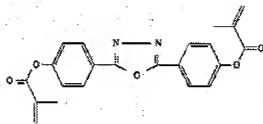


and further include other compounds that transport charge in any manner, expressly including those, which are components of the emitter layer, including photoluminescent materials, such as fluorescent dyes. (column 3, line 20-Column 4, line 2)

34. Concerning claims 3-4, Funhoff et al. describes the substituents on the charge transporting compounds, including ethylenically unsaturated groups such as acrylates, methacrylates, or maleic acid derivatives (column 5, lines 47-48), vinyl ethers (column 5, line 52), or styrenes (column 6, line 43); or cyclic ether moieties such as epoxides. (column 5, line 52)

35. Concerning claim 5, Funhoff et al. describe the charge transporting core structure of the polymerizable composition, including carbazoles or arylamines, as shown above.

36. Concerning claim 11, Funhoff et al. also disclose electron transporting materials as part of the polymerizable compositions, such as the oxadiazole shown below: (column 8)



37. Concerning claim 17-18, Funhoff et al. disclose that the composition may be dissolved **with or without** a cationic or free radical initiator. (column 11, lines 9-10)
38. Concerning claim 19-20, Funhoff et al. disclose that the compositions are formed into layers (solid films) in an electroluminescent device, and crosslinked **thermally or with actinic radiation**. (Column 2, lines 53-55, lines 65-67, column 11, lines 15-16).
39. Concerning claim 21 and 35, Funhoff et al. disclose that the compositions are applied by means of spin coating, dried, and then crosslinked (thermally or by actinic radiation), and can be structured by imagewise exposure (in a predetermined pattern), followed by washing out of unexposed parts. (column 3, lines 8-10).
40. Concerning claims 23-24, 26, and 37-39, Funhoff et al. describe an electroluminescent device comprising a substrate **(1)**, base electrode (anode) **(2)**, hole transport layer **(4)**, emitter layer (light emitting layer) **(5)**, electron-transporting layer **(6)**, and top electrode (cathode) **(8)**. (Figure)
41. Concerning claims 28-29, Funhoff et al. describe the method for forming the film, where the composition is coated on a substrate to form a film, then crosslinking (polymerizing) the composition by means of actinic radiation or by heating (column 11, lines 8-16). Funhoff et al. further disclose that where the film is crosslinked by radiation,

the layers can be directly structured, by imagewise exposure (through a mask), and unexposed parts can be removed by washing. (column 3, lines 7-12)

42. Funhoff et al. are silent on the use of a phosphorescent material as the dopant material in the composition (claim 1), where the triplet energy of the charge transporting fragment is equal to or slightly greater than the energy of the phosphorescent material (claim 2), the nature of the phosphorescent material (claims 13-14), or the percentage of the phosphorescent material in the composition (claims 16 and 34).

43. Concerning claim 1, 13-14, Lamansky et al. describe organic electroluminescent devices comprising polymer charge transport materials doped with phosphorescent dopants, where the polymer is composed of a carbazole moiety (polyvinyl carbazole), the phosphorescent materials are organometallic complexes of transition metals, specifically Pt and Ir. (abstract, Fig. 1) Lamansky et al. report that efficiency of the devices is expected to improve by the use of phosphorescent materials, compared with fluorescent materials due to the fact that phosphorescent materials can utilize both singlet and triplet excited state energy.

44. Concerning claim 2, Lamansky et al. describe several devices with different phosphorescent dopants, with different electroluminescence frequencies (Fig. 4), and discussed the mechanisms for exciton formation, and state that the electroluminescence results, at least partially, from triplet-triplet energy transfer from the host, indicating that the triplet energy of the host material is higher than the dopant material (section 3.4).

45. Concerning claims 16 and 34, Lamansky et al. further disclose a range of doping concentrations for the devices where the phosphorescent material is between 0.6 and 4 wt. % (table 2).

46. Since it is known in the art to dope polymer materials (particularly those with charge transport functions such as carbazoles) with phosphorescent materials to produce electroluminescent devices, it would have been obvious to one of ordinary skill in the art to use phosphorescent materials as the dopant material in the electroluminescent devices described by Funhoff et al. since the devices would be predicted to function, with an improvement in efficiency based on the use of phosphorescent materials compared with fluorescent materials.

47. Claims 27 and 40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Funhoff et al. (5,518,824) and Lamansky et al. (Organic Electronics, vol. 2, no. 1, pp. 53-62, 2001) as applied to claims 1-5, 11,13-14, 16-24, 26, 34-39 above, and further in view of Migliorato et al. (4,834,505).

48. Concerning claims 27 and 40, Funhoff et al. describe electroluminescent devices where the polymer layers are crosslinked by thermal or actinic radiation, as discussed above. Funhoff et al. further disclose that the electroluminescent device is useful for the production of displays (abstract). Funhoff et al. are silent on the use of active matrix addressing in the electroluminescent device, but does disclose the electrical contacts (9) on the electroluminescent device. (Figure)

49. Migliorato et al. describe circuitry useful for liquid crystal displays and electroluminescent cells (column 9, lines 23-29). Migliorato et al. further describe that active matrix addressing is known in the art, to identify uniquely the cell to be switched at any one time and prevent partial switching of other cells. (column 1, lines 16-26).

50. It would have been obvious to one of ordinary skill in the art to use active matrix addressing for the electroluminescent devices described by Funhoff et al. for the purpose of incorporating the electroluminescent device into a display device.

51. Claim 30 is rejected under 35 U.S.C. 103(a) as being unpatentable over Funhoff et al. (5,518,824) and Lamansky et al. (Organic Electronics, vol. 2, no. 1, pp. 53-62, 2001) in view of Okunaka et al. (6,696,181).

52. Concerning claim 30, Funhoff et al. describe an electroluminescent device formed from solid films of a composition of polymerizable material with a dopant, while Lamansky et al. disclose the use of phosphorescent dopants in polymer based electroluminescent devices as discussed above. Funhoff et al. further describe the method of forming the film whereby the composition is treated with heat or actinic radiation to induce polymerization (crosslinking), as discussed above. Funhoff et al. further disclose that where the film is crosslinked by radiation, the layers can be directly structured, by imagewise exposure, and unexposed parts can be removed by washing. (column 3, lines 7-12) Funhoff et al. are silent on an explicit description of the method for forming the layers of the device, where the film is exposed to actinic radiation through a mask and then developed to remove unexposed material.

53. Okunaka et al. describe a method for forming an organic electroluminescent device where a polymerizable composition containing a dopant is deposited on a substrate (column 25, lines 26-36), and then film is crosslinked by exposure to ultraviolet radiation via a photomask. (column 26, lines 25-26) The unexposed area was developed by immersion in N-methylpyrrolidone, followed by rinsing with acetone to remove unexposed material. (column 26, lines 36-39).

54. Given the general teaching by Funhoff et al. that the film can be structured by imagewise exposure, and the specific teaching by Okunaka et al. where the film is exposed to actinic radiation through a photomask, followed by treatment with solvent to remove unexposed material. It would have been obvious to one of ordinary skill in the art to use the specific method described by Okunaka et al. on the device described by Funhoff et al., since the method would be predicted to work in the same manner.

55. Claims 22 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Funhoff et al. (5,518,824) and Lamansky et al. (Organic Electronics, vol. 2, no. 1, pp. 53-62, 2001) as applied to claims 1-5, 11,13-14, 16-24, 26, 28-30, 34-39 above, and further in view of D'Andrade et al. (Advanced Materials, vol. 14, no. 2, pp.147-151, Jan. 2002).

56. Concerning claims 22, and 36, Funhoff et al. describe the formation of thin films and electroluminescent devices formed by crosslinking by thermal or actinic radiation treatment, as discussed above. Funhoff et al. disclose devices with several layers, which are formed on top of each other, where each layer is treated individually prior to

the disposal of the next layer, though the multiple layers do not all include a luminescent material. Funhoff et al. are silent on a device that has at least two solid films that both comprise the polymerizable composition, including the phosphorescent material, or a method of forming a multi-color light-emitting layer.

57. D'Andrade et al. describe multi-color electroluminescent devices, comprising multiple layers, each doped with a phosphorescent material. Each layer emits a different color (Yellow, Red, or Blue, Table 1). The combination of the layers produces white light. D'Andrade et al. disclose that such devices are of interest as alternatives for backlights in flat-panel displays or for use in lighting.

58. It would have been obvious to one of ordinary skill in the art to use the multi-layer light-emitting layer described by D'Andrade et al. in an electroluminescent device described by Funhoff et al. and Lamansky et al. for the purpose of producing a white emitting electroluminescent device.

59. Claims 31-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Funhoff et al. (5,518,824) and Lamansky et al. (Organic Electronics, vol. 2, no. 1, pp. 53-62, 2001) and D'Andrade et al. (Advanced Materials, vol. 14, no. 2, pp.147-151, Jan. 2002) in view of Okunaka et al. (6,696,181).

60. Concerning claims 31-32, Funhoff et al. and Lamansky et al. and D'Andrade et al. describe the electroluminescent device discussed above, comprising multiple light emitting layers, each of which emits a separate color, to form a multicolor organic light

emitting device which emits white light. Funhoff et al. are silent on a method of forming a multicolor device.

61. Okunaka et al. describe the method for forming a film of an electroluminescent device comprising the steps of forming the film, exposing the film to actinic radiation (UV light) through a mask, and developing the layer by treatment with solvent to remove unexposed material, as discussed above.

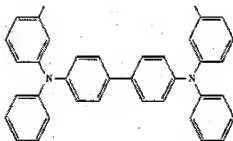
62. It would have been obvious to one of ordinary skill to repeat the process described by Okunaka et al. multiple times for the purpose of layering one layer on top of another to form the multilayer device described by Funhoff et al. and Lamansky et al., in conjunction with D'Andrade et al., since the method would be predicted to be successful.

63. Claims 6-8 rejected under 35 U.S.C. 103(a) as being unpatentable over Funhoff et al. (5,518,824) in view of Lamansky et al. (Organic Electronics, vol. 2, no. 1, pp. 53-62, 2001) as applied to claims 1-5 above, and further in view of Kikuchi et al. (6,416,915).

64. Concerning claims 6-8, Funhoff et al. describes the composition discussed above, where the charge transporting molecule is modified by one or more groups capable of anionic, cationic, or free-radical polymerization, preferably the use of more than one, since network formation takes place more readily (column 6, lines 44-51).

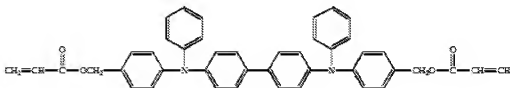
65. Funhoff et al. discloses suitable charge transport molecules such as the molecule shown below, and gives examples of polymerizable substituents as shown above.

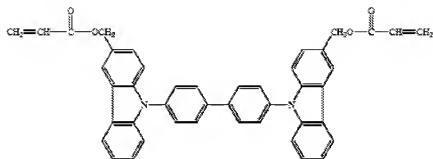
Funhoff et al. are silent on compounds containing polymerizable side chains where the structure is a dimer of triphenylamine as shown below, or where the two aromatic rings have been linked to form a carbazole group.



66. Kikuchi et al. describe polymerizable hole transporting compounds having at least two chain polymerization functional groups in the molecule for use in electrophotographic apparatus (abstract, column 5, lines 7-12). While the materials are not described for use in electroluminescent devices, they are shown to have a hole transporting functionality, as taught by Funhoff et al., and are polymerizable and crosslinkable, as required by Funhoff et al., and would therefore be available to one of ordinary skill.

67. Kikuchi et al. describe hole transport materials formed from polymers having two polymerizable groups, such as those shown below.





68. The materials described have either a carbazole or arylamine structure (per claim 5), and meet the requirements of claim 6 where Ar is biphenyl, and where Ar₁ and Ar₂, as well as Ar₃ and Ar₄ are linked to form carbazole groups, as shown in structure 31.

69. Given the teaching by Funhoff et al. of the use of a polymerizable hole transporting material, and the preference that the polymerizable material be capable of crosslinking, and the teaching by Kikuchi et al. of crosslinkable hole transporting materials used in organic electronic devices for higher levels of mechanical strength and charge transporting performance, it would have been obvious to one of ordinary skill in the art to use the hole transporting material described by Kikuchi et al. in the polymerizable composition described by Funhoff et al.

Response to Arguments

70. Applicant argues that Funhoff et al. does not disclose a combination comprising a cross-linkable charge transport compound with a second polymerizable charge transport component. Funhoff et al. states in claim 2 that the layer contains at least one crosslinkable low molecular weight compound, and additional at least one charge transport compound containing groups which may be crosslinkable. Funhoff et al. also

provide examples of a light emitting material disposed in a crosslinkable layer. Given the teaching of crosslinkable charge transporting compounds, which include light emitting compounds, it would have been obvious to one of ordinary skill to utilize two compounds in the layer, where at least one of them is light emitting in order to form a light emitting layer. Given the fact that phosphorescent compounds are well known as light emitting materials in organic electroluminescent devices, for the purpose of utilizing both singlet and triplet excitons to produce luminescence, as described by Lamansky et al., it would likewise have been obvious to one of ordinary skill to use a phosphorescent material as the light emitting material to take advantage of this property.

71. Applicant argues further that it is difficult to achieve a dispersion of phosphorescent material in a polymer, but provides no support for this assertion. Furthermore, given the teaching by Lamansky et al. of the use of a phosphorescent material in a polymer matrix, it appears that dispersions of phosphorescent materials in a polymeric matrix is well known.

72. Applicant further argues that it was not known whether phosphorescent materials would be stable to the photopolymerization processes, but provides no support for this assertion. However, the same processes which would otherwise damage a phosphorescent material would have similar effect on fluorescent materials, since it is the absorbance of energy, not the emission of energy which results in compound damage, and therefore there is no reason to assume, absent evidence to the contrary, that phosphorescent materials are any less stable or prone to UV damage than other organic or organometallic compounds. Likewise, the claims include **thermal and photo**

polymerization processes. Furthermore, as evidenced by Takeuchi et al. it was known that polymerizable compositions of phosphorescent materials are stable to photopolymerization processes.

73. Applicant further asserts that photopolymerized crosslinked systems with fluorescent dopants demonstrate poor performance, but also provides no support for the assertion. This would however, provide motivation for one of ordinary skill to see to improve the performance, by using more efficient light emitting materials, for example. Applicant points to the examples described in Funhoff et al. which show high operating voltages. However, "applicant must look to the whole reference for what it teaches. Applicant cannot merely rely on the examples and argue that the reference did not teach others." In re Courtright, 377 F.2d 647, 153 USPQ 735,739 (CCPA 1967).

74. Applicant finally argues that the unexpected increase in efficiency was obtained by combining a polymerizable compound with a phosphorescent material, greater than which could be accounted for solely by changing from a fluorescent emitter to a phosphorescent emitter. Applicant provides no evidence to support this assertion however, and as such a comparison cannot be evaluated. It would seem difficult however, to predict exactly how much efficiency improvement would be gained by the use of phosphorescent materials versus fluorescent materials. **In theory**, phosphorescent materials are predicted to have at least three times the efficiency of fluorescent materials, due to the ability to use triplet versus singlet excitation energy. However, **in practice**, individual fluorescent and phosphorescent compounds have their own inherent fluorescent or phosphorescence efficiency, which varies from compound

to compound. The issue is more complex in electroluminescent devices, since electric and photo excitation processes are at work in both systems, which will also vary between individual compounds. For example, a host material with high efficiency for one fluorescent dopant may not be as efficient for a different fluorescent dopant, regardless of the relative fluorescence efficiency of the two fluorescent compounds themselves. The same issues are in play for phosphorescent materials. An increase in efficiency based on a phosphorescent compound compared with a fluorescent compound (even if greater than the theoretical 3x greater), would not necessarily be persuasive for these reasons.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MICHAEL E. NELSON whose telephone number is (571)270-3453. The examiner can normally be reached on M-F 7:30am-5:00pm EST (First Friday Off).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Callie Shosho can be reached on 571-272-1123. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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